SCXI™

SCXI-1104/C User Manual

32-Channel Medium-Voltage Input Module

NATIONAL INSTRUMENTS™

February 2000 Edition
Part Number 322147B-01

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About This Manual

This manual describes the installation, operation, and use of the SCXI-1104 family of modules. The SCXI-1104 family consists of the following modules:

- SCXI-1104
- SCXI-1104C

The SCXI-1104/C modules are members of the National Instruments Signal Conditioning eXtensions for Instrumentation (SCXI) Series that are designed for use with National Instruments data acquisition (DAQ) devices. These modules are designed for signal conditioning of medium-voltage signals—30 VAC_{rms}, ±42 VAC_{peak}, ±60 VDC. The SCXI-1104/C modules have 32 differential analog input channels.

Conventions

The following conventions appear in this manual:

<> — Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DBIO<3..0>.

♦ — The ♦ symbol indicates that the following text applies only to a specific product, a specific operating system, or a specific software version.

— This icon denotes a note, which alerts you to important information.

— This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

bold — Bold text denotes items that you must select or click on in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

italic — Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.
`monospace bold`	Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.
SCXI-1104/C	Refers to both the SCXI-1104 and SCXI-1104C modules.

Related Documentation

The *SCXI-1104/C User Manual* is one piece of the documentation set for your data acquisition system. You could have any of several types of manuals, depending on the hardware and software in your system. Use the manuals you have as follows:

- *SCXI Quick Start Guide*— This document describes how to quickly install and configure your SCXI module.
- *Getting Started with SCXI*—This is the first manual you should read. It gives an overview of the SCXI system and contains the most commonly needed information for the modules, chassis, and software.
- Your SCXI module user manuals—Read these manuals next for detailed information about signal connections and module configuration. They also explain in greater detail how the module works and contain application hints.
- Your DAQ hardware user manuals—These manuals have detailed information about the DAQ hardware that plugs into or is connected to your computer. Use these manuals for hardware installation and configuration instructions, specification information about your DAQ hardware, and application hints.
- Software manuals—Examples of software manuals you may have are the LabVIEW and LabWindows/CVI manual sets and the NI-DAQ manuals. After you set up your hardware system, use either the application software (LabVIEW or LabWindows) manuals or the NI-DAQ manuals to help you write your application. If you have a large and complicated system, review the software manuals before you configure your hardware.

- Accessory installation guides or manuals—Consult these guides when you are installing terminal blocks, cable assemblies, or other SCXI accessories.
- SCXI chassis manual—Read this manual to obtain chassis installation instructions and maintenance information.

1

Introduction

This chapter describes the SCXI-1104/C modules, lists what you need to get started, and explains how to unpack the module. A table at the end of this chapter lists vendors who manufacture mating connectors for developing custom cables.

About the SCXI-1104/C Module

The SCXI-1104/C modules are for signal conditioning medium-voltage signals. The SCXI-1104/C has 32 differential analog input channels. Each channel also has a divide-by-10 attenuator stage before the amplifier. You can multiplex the SCXI-1104/C inputs to a single module output that drives a DAQ device input channel.

- SCXI-1104
  On each channel, the SCXI-1104 has a three-pole lowpass filter with a 2 Hz cutoff frequency to reject 60 Hz noise.

- SCXI-1104C
  On each channel, the SCXI-1104C has a three-pole lowpass filter with a 10 kHz cutoff frequency.

Detailed specifications of the SCXI-1104/C modules are in Appendix A, *Specifications*. Figure 5-1, *SCXI-1104/C Module Block Diagram*, shows a block diagram of the SCXI-1104/C.

What You Need to Get Started

To install, configure, and use your SCXI-1104/C, you will need the following items:

- ❑ One of the following modules
  - SCXI-1104
  - SCXI-1104C
- ❑ *SCXI-1104/C User Manual*
- ❑ One of the following connectivity devices
  - SCXI-1300
  - BNC-2095
  - TBX-96
  - SCXI-1310
- ❑ One of the following software packages and its documentation
  - ComponentWorks
  - LabVIEW for Macintosh
  - LabVIEW for Windows
  - LabWindows/CVI for Windows
  - Measure
  - VirtualBench
- ❑ One of the following device drivers
  - NI-DAQ for Macintosh
  - NI-DAQ for PC Compatibles
- ❑ Your computer with an installed DAQ device
- ❑ An SCXI chassis with an AC power cord and the appropriate cable assembly
- ❑ Small Phillips-head screwdriver
- ❑ 1/4 in. flathead screwdriver

Unpacking

Your SCXI-1104/C module is shipped in an antistatic package to prevent electrostatic damage to the module. Electrostatic discharge can damage several components in the module. To avoid damaging the module, take the following precautions:

- Ground yourself using a grounding strap or by holding a grounded object.
- Touch the antistatic package to a metal part of your SCXI chassis before removing the module from the package.
- Remove the module from the package and inspect the module for loose components or any other sign of damage. Notify National Instruments if the module appears damaged in any way. *Do not* install a damaged module into your SCXI chassis.
- *Never* touch the exposed pins of connectors.

Custom Cable Components

To develop custom cables, consult the following table.

Signal Connector	SCXI–1104/C Connector	Mating Connector	Cable
Rear	AMP Inc. 50-pin male ribbon-cable header	Electronic Products Division/3M or T&B/Ansley Corp. 50-position polarized ribbon-socket female connector	Electronic Products Division/3M or T&B/Ansley Corp. 50-conductor, 28 AWG stranded ribbon cable
Front	Harting Electronik Inc. 96-pin DIN C male connector	AMP Inc. (right-angle pins) or Panduit Corp. (straight-solder pins) 96-pin, polarized, DIN C female connector	Not applicable

2

Installation and Configuration

This chapter describes how to install and configure the SCXI-1104/C module. The SCXI-1104/C is a jumperless module and requires no user modifications. There is no need for the user to remove the module cover.

Note The SCXI-1104/C does not support ribbon-cabled multichassis SCXI systems. You must use the SCXI-1346 multichassis adapter in a multichassis system.

Installing the Software

You can control the SCXI-1104/C in an application development environment (ADE) using the NI-DAQ data acquisition device driver software. The supported ADEs include LabVIEW, BridgeVIEW, LabWindows/CVI, Visual Basic (ComponentWorks), C, and C++ environments. You can also use the SCXI-1104/C in conjunction with VirtualBench and Measure. The following instructions describe the order for installing the software for your SCXI-1104/C:

1. Install your ADE if you have not already done so. National Instruments ADEs have release notes containing software installation instructions.
2. Install the appropriate version of NI-DAQ software. NI-DAQ version 6.5.1 or higher is required to configure and program your SCXI-1104 module. NI-DAQ version 6.7 or higher is required to configure and program your SCXI-1104C module. If you do not have the correct NI-DAQ version, you can either contact a National Instruments sales representative or download the latest NI-DAQ version from the National Instruments Web site, `www.ni.com`. See Appendix B, *Common Questions*, for information on getting the latest version of NI-DAQ.
    a. If you have the required version of NI-DAQ, insert your National Instruments NI-DAQ software CD into the CD-ROM drive.
    b. Click on the **Install NI-DAQ Software** option in the installation window. The installer guides you through the rest of the installation process.

Installing the SCXI-1104/C

The following section describes how to install your SCXI-1104/C for use with SCXI chassis and National Instruments DAQ devices.

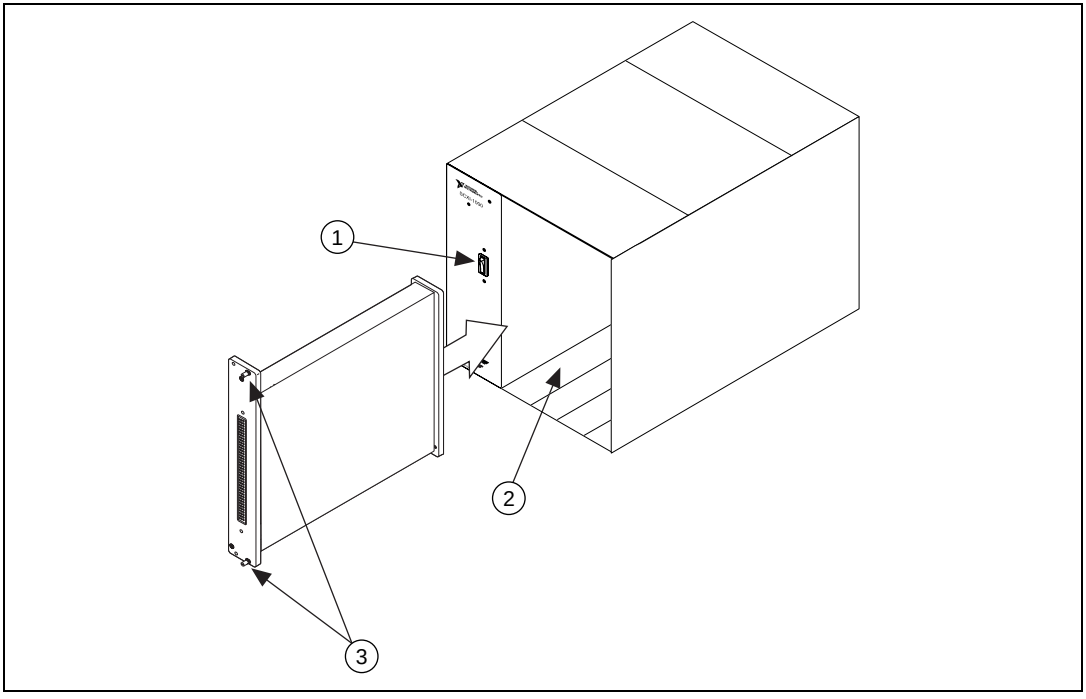
Installing the SCXI-1104/C Module into the SCXI Chassis

You need the following items to complete the installation:

- SCXI-1104/C module(s)
- SCXI chassis or PXI combination chassis
- 1/4 in. flathead screwdriver

To install your SCXI-1104/C module into the SCXI chassis, follow these steps while referring to Figure 2-1:

1. Turn off the computer that contains the DAQ device or disconnect it from your SCXI chassis.
2. Turn off the SCXI chassis. *Do not* insert the SCXI-1104/C module into a chassis that is turned on.
3. Insert the SCXI-1104/C into an open slot in the SCXI chassis. Gently guide the module into the slot guides and push it to the back of the slot until the front face of the module is flush with the front of the chassis.
4. Insert any other SCXI modules into the remaining slots in the same manner as described in step 3.
5. Secure all the SCXI modules to the SCXI chassis using both thumbscrews.



1 SCXI Chassis Power Switch 2 SCXI Chassis Slots 3 SCXI Module Thumbscrews

Figure 2-1. Installing the SCXI-1104/C Module

To complete your SCXI-1104/C installation, follow the procedure in the appropriate sections that follow.

Connecting the SCXI-1104/C to a DAQ Device for Multiplexed Scanning in an SCXI Chassis

This configuration allows you to multiplex all 32 input channels of the SCXI-1104/C into a single channel of your DAQ device. You need the following items for this installation:

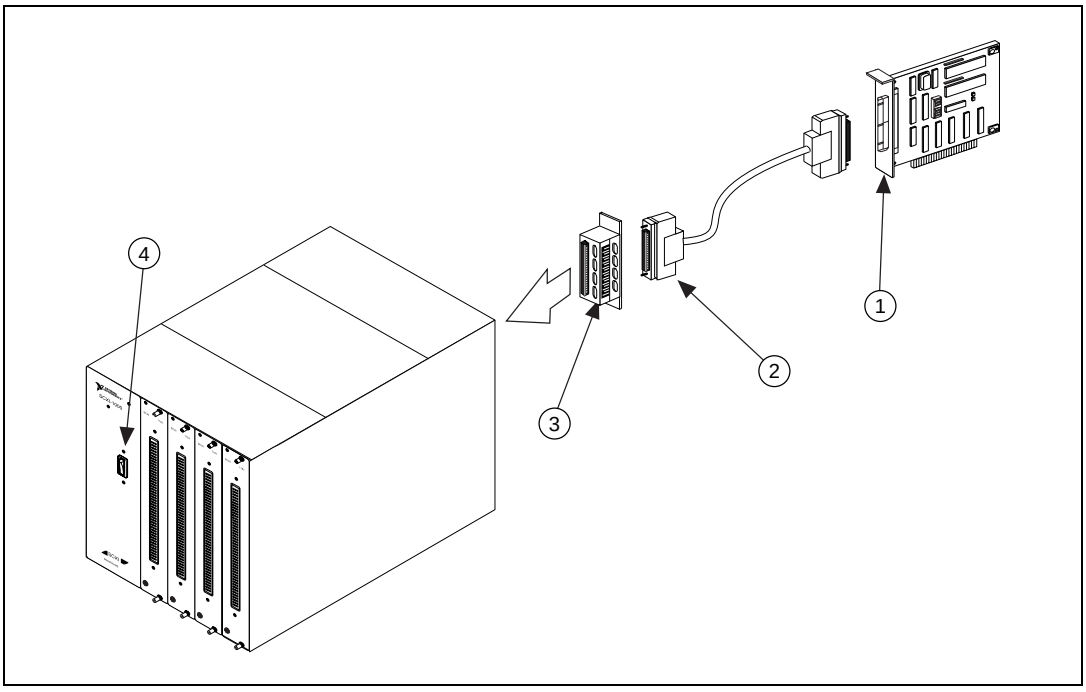
- SCXI chassis with the SCXI modules installed
- SCXI cable assembly, which consists of a cable adapter and a cable
- An installed National Instruments DAQ device
- 1/4 in. flathead screwdriver

Consult your SCXI chassis documentation, other SCXI module documentation, and DAQ device documentation for additional instructions and warnings. Your SCXI-1104/C module and any other SCXI modules

should already be installed in the chassis according to their installation instructions.

You must select one of the analog input modules in the chassis to be the cabled module, the module to which the SCXI cable assembly will be connected. If the chassis contains at least one simultaneous sampling module such as the SCXI-1140, SCXI-1530, or SCXI-1531 module, select one of these modules to be the cabled module; otherwise, select one of the remaining analog input modules. To connect the chassis to a DAQ device for multiplexed operation, complete the following steps while referring to Figure 2-2:

1. Turn off the SCXI chassis and the computer that contains the DAQ device.
2. Insert the cable adapter into the back of the SCXI chassis aligned with the module that is to be connected to the DAQ device. See the installation guide for your cable assembly for more information.
3. Connect the cable to the back of the cable adapter ensuring that the cable fits securely.
4. Connect the other end of the cable to the DAQ device that you will use to control the SCXI system.
5. Check the cable installation, making sure the connectors are securely fastened at both ends.
6. Turn on the SCXI chassis.
7. Turn on the computer.
8. If you have already installed the appropriate software, you are ready to configure the SCXI-1104/C module(s) for multiplexed mode operation. See *Configuration and Self-Test* in this chapter.



1 DAQ Device	3 Cable Adapter
2 Cable	4 SCXI Chassis Power Switch

Figure 2-2. Connecting an SCXI Chassis to a DAQ Device

Connecting the SCXI-1104/C to a DAQ Device for Multiplexed Scanning in a PXI Combination Chassis

This configuration allows you to multiplex all 32 channels of your SCXI-1104/C into a single channel of your DAQ device in a combination PXI chassis. You need the following items for this installation:

- PXI combination chassis with the SCXI modules installed
- National Instruments PXI-MIO DAQ device installed in the right-most slot

Consult your PXI chassis documentation, other SCXI module documentation, and DAQ device documentation for additional instructions and warnings. You should have already installed your SCXI-1104/C module and any other SCXI modules in the chassis according to their

installation instructions. To use the SCXI-1104/C module in multiplexed mode with a DAQ device in a PXI combination chassis, follow these steps:

1. No cables are required between the SCXI-1104/C and DAQ device if the National Instruments PXI DAQ device is installed in the right-most slot. This device can be configured to control the SCXI system using an internal bus that connects the PXI chassis to the SCXI chassis. If the DAQ device for controlling the SCXI system is not installed in the right-most slot of the PXI combination chassis, configure the system as described earlier in *Connecting the SCXI-1104/C to a DAQ Device for Multiplexed Scanning in an SCXI Chassis*.
2. Turn on the SCXI chassis.

If you have already installed the appropriate software, you are ready to configure the SCXI-1104/C for multiplexed mode operation.

Configuration and Self-Test

Run Measurement & Automation Explorer to configure and test your SCXI-1104/C. If you need help during the configuration process, open the Measurement & Automation Help file by selecting **Help Topics** from the **Help** menu. Follow these steps to configure your SCXI system:

1. Double-click the **Measurement & Automation Explorer** icon on your desktop. Click the **+** next to the **Devices and Interfaces** icon.

   If you have added new modules to an existing chassis, go to step 4. If you inserted modules into an empty chassis, go to step 2.
2. Add a new chassis to the configured **Devices and Interfaces** by holding down the right mouse button on **Devices and Interfaces** and selecting **Insert**. Select the appropriate chassis from the list box and click **OK**.
3. Configure the chassis by selecting a **Chassis ID**. This is an integer value you choose to uniquely identify the chassis for programming and scanning. Select the **Chassis Address**. This is needed to address the chassis in a multichassis SCXI system. Unless you are using multiple chassis with the same DAQ device, select a Chassis Address of zero, which is the factory-default setting of all SCXI chassis. If you are using multiple chassis, refer to your SCXI chassis user manual for further information. For remote SCXI chassis, you also need to select the **Baud Rate** and **COM Port**. After completing the chassis configuration, click **Next.**

4. You now have the choice of automatically detecting which modules are installed in the chassis or manually adding them.
   - If you have just added the chassis to **Devices and Interfaces** and are using an E Series or 1200 DAQ device, you can automatically detect the modules.
   - If the chassis was already listed in **Devices and Interfaces**, you must add new modules manually.

Go to the appropriate section that follows to continue the software configuration of your chassis.

Auto-Detecting Modules

If you selected auto-detect, your chassis must be connected to your DAQ device, except in the case of a remote chassis, which must connect to the computer using a serial port cable.

Before auto-detecting modules, do the four steps of the *Configuration and Self-Test* section.

To auto-detect your SCXI module(s), follow these steps:

1. Make sure the chassis power is turned on.
2. Select **Yes** under **Auto-Detect modules** and click **Next**. If your chassis is a remote SCXI chassis, go to step 4, otherwise go to step 3.
3. Select your communication path and click **Next**. If modules were detected, select the module connected to your DAQ device as your communication path.
4. Click **Finish**.

Your Measurement & Automation Explorer software should now recognize your SCXI chassis and SCXI module(s). If the software did not recognize your module(s), check your cable connections and retry auto-detecting or try installing the modules manually before taking troubleshooting measures. If the software recognized any module as an SCXI custom module, you may be using the wrong version of NI-DAQ. See Appendix B**,** *Common Questions*, for information on getting the latest version of NI-DAQ.

Manually Adding Modules

If you did not auto-detect your SCXI modules, you must add each of your modules separately. If you are still in the Chassis Configuration window, select **No** under **Auto-Detect modules** and click **Finish**. Use the following steps to manually add modules:

1. Display the list of devices and interfaces by clicking the + next to the **Devices and Interfaces** icon.
2. Locate the SCXI chassis in the list. Display the list of modules in the chassis by clicking the + next to the **Chassis** icon.
3. Right-click the appropriate installation slot and click **Insert**.
4. Select the module installed in that slot and click **Next**. If the appropriate module name does not appear on the list, you may be using the incorrect version of NI-DAQ. See Appendix B**,** *Common Questions*, for information on getting the latest version of NI-DAQ.
5. Configure your module as follows:
   a. If the selected module is connected to a National Instruments DAQ device, select that device by using the **Connected to** control. If it is not, select **none**. If you want this DAQ device to control the chassis, confirm that there is a check in the checkbox labeled **This device will control the chassis**.
   b. Select the multiplexed scanning mode for your SCXI-1104/C by using the **Operating Mode** control. Click **Next**.
   c. Review the gain and filter settings for all channels on the SCXI-1104/C. Click **Next**.
   d. Select the accessory you are using with this module. When you have completed configuration, click **Finish**.

If you need to manually install more SCXI-1104/C modules in your chassis, repeat steps 3 through 5 to configure each module.

Your SCXI chassis and SCXI module(s) should now be configured properly. If you need to change your module configuration, see the next section, *Configuring the SCXI-1104/C*. If your configuration is complete, test the system as described in *Self-Test Verification* in this chapter to ensure your SCXI system is communicating properly with the DAQ device.

Configuring the SCXI-1104/C

To configure your SCXI-1104/C after auto-detection, or to alter your original configuration selections, you must use the configuration utility in Measurement & Automation Explorer. Perform the following steps to configure your SCXI-1104/C:

1. Run Measurement & Automation Explorer by double-clicking its icon on your desktop.
2. Display the list of installed devices and interfaces by clicking the + next to the **Devices and Interfaces** icon.
3. Locate the SCXI chassis in the list. Display the list of modules in the chassis by clicking the + next to the **Chassis** icon.
4. Right-click on the SCXI-1104/C module you want to configure and select **Properties**. Click on the **General** tab.
   a. If the module you are configuring is connected to a National Instruments DAQ device, select that device by using the **Connected to** control. If you want this DAQ device to control the chassis, confirm that there is a check in the checkbox labeled **This device will control the chassis**. If the module you are configuring is not connected to a National Instruments DAQ device, select **none**.
   b. Select the multiplexed scanning mode for your SCXI-1104/C by using the **Operating Mode** control.
5. Click on the **Channel** tab. Review the gain and filter settings for all channels on the SCXI-1104/C.
6. Click on the **Accessory** tab. Select the accessory you are using with this module. When all of your configurations are completed, click **OK**.

Your SCXI chassis and SCXI module(s) should now be configured properly. Test the system in the section that follows to ensure your SCXI system is communicating properly with the DAQ device.

Self-Test Verification

To test the successful configuration of your system, follow the steps that follow after entering the Measurement & Automation Explorer utility:

1. Verify the chassis is on and correctly connected to a DAQ device.
2. Display the list of Devices and Interfaces by clicking the + next to the **Devices and Interfaces** icon.
3. From the list that appears, locate the chassis you want to test. Right-click on the chassis and select **Test**.
4. If the communication test is successful, a message **`The chassis has been verified`** appears. Click **OK**.

Your SCXI system should now operate properly with your ADE software. If the test did not complete successfully, see the following section for troubleshooting steps.

Troubleshooting Self-Test Verification

If the preceding test did not verify your chassis configuration, take the following steps to successfully complete system configuration:

1. If you get the warning message **`Unable to test chassis at this time`**, you have not designated at least one module as connected to a DAQ device. Return to the *Configuring the SCXI-1104/C* section and change the configuration of the cabled module in your system from **Connected to: None** to **Connected to: Device *x***.
2. If you get the warning message **`Failed to find`** followed by the module codes and the message **`Unable to communicate with chassis`**, take the following troubleshooting actions.
   a. Make sure the SCXI chassis is on.
   b. Make sure the cable between the SCXI chassis and DAQ device is properly connected.
   c. Inspect the cable connectors for bent pins.
   d. Make sure you are using the correct National Instruments cable assembly.
   e. Test your DAQ device to verify it is working properly. See your DAQ device user manual for more information.

3. If you get the warning message **`Failed to find`**, followed by module codes and then the message **`Instead found: module with ID 0Xxx`**, return to the *Configuring the SCXI-1104/C* section and make sure the correct module is in the specified slot. Delete the incorrect module as described in the *Removing the SCXI-1104/C from Measurement & Automation Explorer* section and then add the correct module as described in the *Manually Adding Modules* section.
4. If you get the warning message **`Failed to find`**, followed by a module code and then the message **`Slot x is empty`**, check to see if the configured module is installed in the specified slot. If not, install the module by referring to the previous section, *Installing the SCXI-1104/C Module into the SCXI Chassis*. If the module is installed in the correct slot, turn off the chassis, remove the module as specified in *Removing the SCXI-1104/C from an SCXI Chassis*, and verify that no connector pins are bent on the rear signal connector. Reinstall the module as shown in *Installing the SCXI-1104/C Module into the SCXI Chassis*, ensuring the module is fully inserted and properly aligned in the slot.
5. After checking the preceding items, return to the *Self-Test Verification* section and retest your SCXI chassis.

If these measures do not successfully configure your SCXI system, see Appendix B**,** *Common Questions*, for more information.

Removing the SCXI-1104/C

This section will show you how to remove the SCXI-1104/C from an SCXI chassis.

Removing the SCXI-1104/C from an SCXI Chassis

Only a qualified person who has read and understands all the safety information in this manual should remove an SCXI module, disconnect signals, or remove the SCXI-1104/C from the chassis. You need the following items to remove the SCXI-1104/C module:

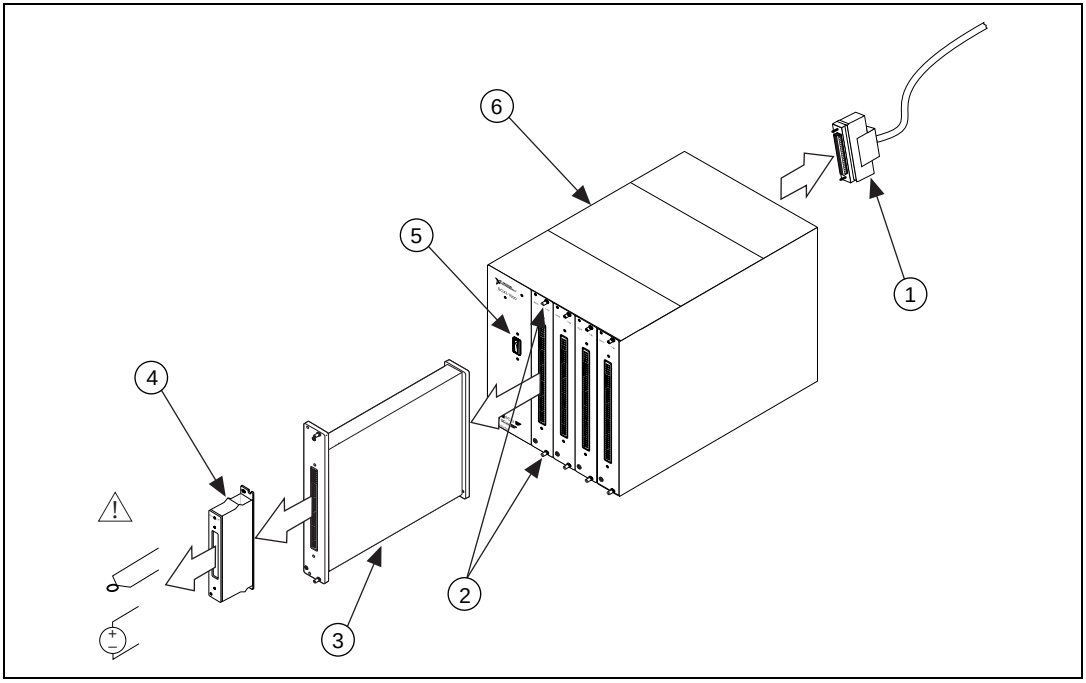
- SCXI chassis or PXI combination chassis with the SCXI-1104/C module(s) installed
- 1/4 in. flathead screwdriver

Consult the documentation for your SCXI/PXI chassis and accessories for additional instructions and warnings. To remove the SCXI-1104/C module from an SCXI chassis follow the steps that follow while referring to Figure 2-3:

1. If the SCXI-1104/C is the cabled module, disconnect the cable running from the SCXI-1104/C to the DAQ device.

Caution Read the safety information in the appropriate section that follows and in the associated terminal block installation guide before adding or removing any signals from the SCXI module or terminal block.

2. Remove all signals from the terminal block connected to the SCXI-1104/C.
3. Remove any terminal blocks connected to the SCXI-1104/C.
4. Turn off the SCXI chassis. Do not remove the SCXI-1104/C module from a chassis that is turned on.
5. Rotate the thumbscrews that secure the SCXI-1104/C to the chassis counter-clockwise until they are loose, but do not completely remove the thumbscrews.
6. Remove the SCXI-1104/C by pulling steadily on both thumbscrews until the module slides completely out.



1	Cable	3	SCXI-1104/C	5	SCXI Chassis Power Switch
2	SCXI Module Thumbscrews	4	Terminal Block	6	SCXI Chassis

Figure 2-3. Removing the SCXI-1104/C

Removing the SCXI-1104/C from Measurement & Automation Explorer

To remove a module from Measurement & Automation Explorer, take the following steps after entering the Measurement & Automation Explorer utility:

1. Display the list of installed devices and interfaces by clicking the + next to the **Devices and Interfaces** icon.
2. Locate the chassis in the list of installed devices. Display the list of modules in the chassis by clicking the + next to the **Chassis** icon.
3. Right-click the module or chassis you want to delete and select **Delete**.
4. You will be presented a confirmation window. Click **Yes** to continue deleting the module or chassis or **No** to cancel this action.

Note Deleting the SCXI chassis deletes all modules in the chassis. All configuration information for these modules is also lost.

Your SCXI chassis and/or SCXI module(s) should now be removed from the list of installed devices in Measurement & Automation Explorer.

3

Signal Connections

This chapter describes the input and output signal connections to the SCXI-1104/C module using the front and rear signal connectors. This chapter also includes specifications and connection instructions for the signals on SCXI-1104/C connectors.

Caution Static electricity is a major cause of component failure. To prevent damage to the electrical components in the module, use antistatic techniques whenever removing a module from the chassis or whenever touching a module.

The following accessories are available to connect signals to the front of an SCXI-1104/C module:

- SCXI-1300 screw-terminal connection front-mount terminal block
- SCXI-1310 solder-connection front-mount connector and shell assembly
- BNC-2095 BNC-connection rack-mount accessory
- TBX-96 screw terminal connection DIN-rail terminal block

Installation guides for these accessories may contain useful signal-connection information beyond what is given in this chapter.

Front Signal Connector

Figure 3-1 shows the pin assignments for the SCXI-1104/C module front signal connector.

	A		B		C
CGND	32	CH0–	32	CH0+	32
NC	31	CH1–	31	CH1+	31
NC	30	CH2–	30	CH2+	30
NC	29	CH3–	29	CH3+	29
NC	28	CH4–	28	CH4+	28
NC	27	CH5–	27	CH5+	27
NC	26	CH6–	26	CH6+	26
NC	25	CH7–	25	CH7+	25
CGND	24	CH8–	24	CH8+	24
NC	23	CH9–	23	CH9+	23
NC	22	CH10–	22	CH10+	22
NC	21	CH11–	21	CH11+	21
NC	20	CH12–	20	CH12+	20
NC	19	CH13–	19	CH13+	19
NC	18	CH14–	18	CH14+	18
NC	17	CH15–	17	CH15+	17
CGND	16	CH16–	16	CH16+	16
NC	15	CH17–	15	CH17+	15
NC	14	CH18–	14	CH18+	14
NC	13	CH19–	13	CH19+	13
NC	12	CH20–	12	CH20+	12
NC	11	CH21–	11	CH21+	11
NC	10	CH22–	10	CH22+	10
NC	9	CH23–	9	CH23+	9
NC	8	CH24–	8	CH24+	8
NC	7	CH25–	7	CH25+	7
NC	6	CH26–	6	CH26+	6
CGND	5	CH27–	5	CH27+	5
RSVD	4	CH28–	4	CH28+	4
RSVD	3	CH29–	3	CH29+	3
CGND	2	CH30–	2	CH30+	2
+5 V	1	CH31–	1	CH31+	1

Figure 3-1. SCXI-1104/C Module Front Signal Connector Pin Assignments

Front Signal Connector Signal Descriptions

Pin	Signal Name	Description
A1	+5 V	+5 VDC Source
A2, A5, A16, A24, A32	CGND	Chassis Ground—Tied to the SCXI chassis.
A3, A4	RSVD	Reserved
B1–B32	CH31– through CH0–	Negative Input Channels—Negative side of differential input channels.
C1–C32	CH31+ through CH0+	Positive Input Channels—Positive side of differential input channels.
All other pins are not connected.		

Analog Input Signal Connections

The signal terminals for the positive input channels are found in Figure 3-1 column C. The signal terminal for each corresponding negative input channel is found in Figure 3-1 column B. Each input pair goes to a separate filter and amplifier that is multiplexed to the module output buffer as shown in Figure 5-1.

The differential input signal range of an SCXI-1104/C module input channel is 30 VAC_{rms}, ±42 VAC_{peak}, and ±60 VDC. This differential input range is the maximum measurable voltage difference between the positive and negative channel inputs. The common-mode input signal range of an SCXI-1104/C module input channel is ±60 VDC with respect to the chassis ground. This common-mode input range for either positive or negative channel input terminal is the maximum input voltage that results in a valid measurement.

Subject to the limits stated above, you can connect either floating or ground-referenced signal sources to the SCXI-1104/C input channels without using bias resistors.

Cautions Exceeding the input damage level (±42 VAC_{peak} or 60 VDC between input channels and chassis ground) can damage the SCXI-1104/C module, the SCXIbus, and the DAQ device. National Instruments is *not* liable for any damage or injuries resulting from such signal connections.

Applying a voltage greater than ±42 VAC_{peak} or 60 VDC to the SCXI-1104/C is an electrical shock hazard. National Instruments is *not* liable for any damages or injuries resulting from such voltage application.

Rear Signal Connector

Note If you are using the SCXI-1104/C module with a National Instruments DAQ device and cable assembly, you do not need to read the remainder of this chapter. If you are using the SCXI-1180 feedthrough panel, the SCXI-1343 rear screw terminal adapter, or the SCXI-1351 one-slot cable extender with the SCXI-1104/C module, read this section.

Figure 3-2 shows the SCXI-1104/C module rear signal connector pin assignments.

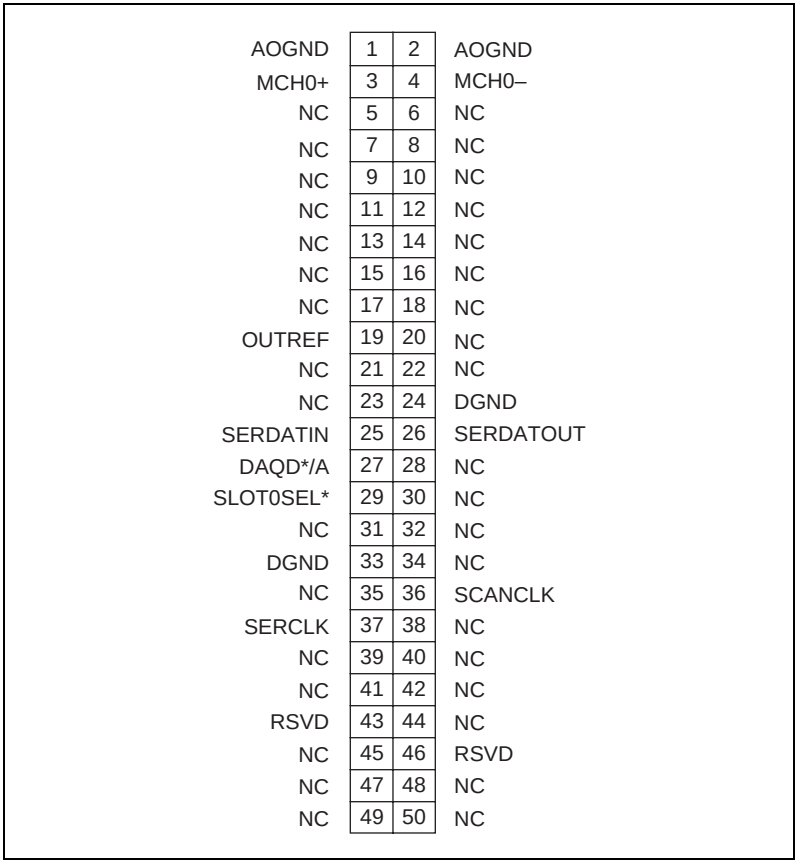

AOGND 1 2 AOGND
MCH0+ 3 4 MCH0–
NC 5 6 NC
NC 7 8 NC
NC 9 10 NC
NC 11 12 NC
NC 13 14 NC
NC 15 16 NC
NC 17 18 NC
OUTREF 19 20 NC
NC 21 22 NC
NC 23 24 DGND
SERDATIN 25 26 SERDATOUT
DAQD*/A 27 28 NC
SLOT0SEL* 29 30 NC
NC 31 32 NC
DGND 33 34 NC
NC 35 36 SCANCLK
SERCLK 37 38 NC
NC 39 40 NC
NC 41 42 NC
RSVD 43 44 NC
NC 45 46 RSVD
NC 47 48 NC
NC 49 50 NC

Figure 3-2. SCXI-1104/C Module Rear Signal Connector Pin Assignments

Rear Signal Connector Descriptions

The rear signal connector on the cabled module is the interface between the DAQ device and all modules in the SCXI chassis.

Pin	Signal Name	Direction	Description
1, 2	AOGND	Output	Negative Module Analog Output—With software, you can configure these pins to connect to the analog reference.
3	MCH0+	Output	Positive Module Analog Output—This pin connects to the positive side of the differential analog input channel 0 of the DAQ device.
4	MCH0–	Output	Negative Module Analog Output—In the reset state of the module, this pin is configured to connect to the analog reference.
19	OUTREF	Output	Negative Module Analog Output—With software, you can configure this pin to connect to the analog reference.
24, 33	DGND	—	Digital Ground—These pins supply the reference for DAQ device digital signals and are tied to the module digital ground.
25	SERDATIN	Input	Serial Data In—The DAQ device uses this signal to program modules in all slots.
26	SERDATOUT	Output	Serial Data Out—A cabled module uses this signal to return data from any module to the DAQ device.
27	DAQD*/A	Input	DAQ Device Data/Address Line—The DAQ device asserts this signal to indicate to the module whether the incoming serial stream is data or address information.
29	SLOT0SEL*	Input	Slot 0 Select—The DAQ device asserts this signal low to indicate that the SERDATIN line information is going to the Slot 0 controller instead of a module.
36	SCANCLK	Input	Scan Clock—A rising edge indicates to the scanned SCXI module that the DAQ device has taken a sample and causes the module to advance channels.
37	SERCLK	Input	Serial Clock—This signal clocks the data on the SERDATIN and SERDATOUT lines.
43, 46	RSVD	Input	Reserved

All other pins are not connected.
* means that the signal is asserted low.

Analog Output Signal Connections

Pins 1 through 4 and pin 19 of the rear signal connector are analog output signal pins. With software, you can configure pin 1, 2, 4 or 19 to connect to the analog ground (AGND) of the module. You can use the pin that is connected to AGND as a general analog power ground tie point to the SCXI-1104/C module, if necessary.

Caution The SCXI-1104/C module analog output is *not* overvoltage-protected. Applying external voltages to this output can damage the SCXI-1104/C module. National Instruments is *not* liable for any damage resulting from such signal connections.

Note The SCXI-1104/C module analog outputs are short-circuit protected.

Digital I/O Signal Connections

Pins 24 through 27, 29, 33, 36, 37, 43, and 46 constitute the digital I/O lines of the rear signal connector.

The SCXI-1104/C module digital input and output signals correspond to the digital I/O lines of E Series MIO DAQ devices. Table 3-1 lists the equivalencies.

Table 3-1. SCXIbus to SCXI-1104/C Module Rear Signal Connector to DAQ Device Pin Equivalencies

SCXIbus Line	SCXI-1104/C Rear Signal Connector	E Series MIO DAQ Device
MOSI	SERDATIN	DIO0
D*/A	DAQD*/A	DIO1
INTR*	SLOT0SEL*	DIO2
SPICLK	SERCLK	EXTSTROBE*
MISO	SERDATOUT	DIO4
TRIG0	SCANCLK	SCANCLK

4

Programming

You can configure the SCXI-1104/C to operate in multiplexed scanning mode as described in Chapter 2, *Installation and Configuration*. Using this mode of operation, you can sequentially route all input channels of the SCXI-1104/C to one output channel that is connected to a single input channel on a DAQ device. Digital timing signals automatically synchronize the module multiplexer with the DAQ device analog-to-digital converter (ADC), permitting the NI-DAQ driver software to match up voltage readings with the channel of origin. The power of SCXI multiplexed scanning is its ability to route many conditioned input channels, spanning many modules or chassis, to a single input channel on a DAQ device.

When you configure a module for multiplexed operation, the physical routing of multiplexed signals to the DAQ device depends on which module in the SCXI system is the cabled module. The cabled module is the module that connects directly to the DAQ device using an SCXI cable assembly. If the module you are scanning is not directly cabled to the DAQ device, the module routes its output signal through the SCXIbus to the cabled module. The cabled module, whose internal routing is controlled by the SCXI chassis, routes the SCXIbus signal through internal analog bus switches to the DAQ device. It uses the MCH0 terminals on the rear signal connector as shown in Figure 3-2, *SCXI-1104/C Module Rear Signal Connector Pin Assignments* and Figure 5-1, *SCXI-1104/C Module Block Diagram*. If the module you are scanning is the cabled module, the inputs signals pass through the multiplexer of the module directly to the MCH0 terminals without the aid of the SCXIbus.

Immediately prior to a multiplexed scanning operation, the SCXI chassis (Slot 0) is programmed with a module scan list that controls which module sends it output to the SCXIbus during a scan. You can specify this list to scan the modules in any order, with an arbitrary number of channels for each module entry in the list, limited to a total of 512 channels per chassis.

When using LabVIEW or BridgeVIEW to develop an SCXI application, all the above details are taken care of automatically. If you are using a C-based ADE, more programming effort is required to set up a multiplexed scan.

Channel Addressing

Performing scanning operations in software depends on the ADE you are using. While using LabVIEW, Measure, or Visual Basic (ComponentWorks), all scanning operations are prepared in software by using an SCXI *channel string* as the input to the channel parameter in the analog input VI or function. These ADEs also support virtual channels using Data Neighborhood (DAQ Channel Wizard) in Measurement & Automation Explorer. In LabWindows/CVI, C, or C++ development environments, several NI-DAQ function calls need to be made to set up each module involved in the scan, the chassis, and the DAQ device controlling the scan. In Virtual Bench, the instruments that support SCXI scanning configure the channels of the module in a menu item in the graphical user interface. In BridgeVIEW, SCXI channels must be configured as virtual channels (tags) in Measurement & Automation Explorer.

A discussion describing how to implement multiplexed scanning in the different ADEs follows. See your ADE manual and the DAQ analog input examples that come with your application software for more detailed information on programming your SCXI modules for scanning in multiplexed mode.

LabVIEW and the SCXI Channel String

For LabVIEW, Measure, and Visual Basic, the channel string determines the sequence in which SCXI channels are scanned. In LabVIEW, an array of these channel strings configures multiple modules in the scan list. When the application program runs, the channel string is used for programming the channel information into the SCXI system. The format of the channel string is as follows:

ob***x*** ! sc***y*** ! md***z*** ! ***channels***

where

ob***x*** is the onboard DAQ device channel, with *x* representing a particular channel where the multiplexed channels are sent. This value is 0 for DAQ channel 0 in a single-chassis system. In a multichassis or remote chassis system, however, the DAQ device channel *x* corresponds to chassis number *n*-1, where DAQ device channel *x* is used for scanning the *n*th chassis in the system.

sc***y*** is the SCXI chassis ID, where *y* is the number you chose when configuring your chassis.

md***z*** is the slot position where the module is located, with *z* being the particular slot number. The slots in a chassis are numbered from left to right, starting with 1.

Note Note that the ob*x* ! specifier is optional and causes the gains on the module and DAQ device to be automatically set to fit the input limits parameter. When this specifier is omitted, the default gain on the DAQ device, usually the lowest gain, is used.

The last parameter, ***channels***, is the list of channels scanned for module ***z***. It can have several formats:

- ob***x*** ! sc***y*** ! md***z*** ! ***n***, where ***n*** is a single input channel.
- ob***x*** ! sc***y*** ! md***z*** ! ***n1:n2***, where ***n1*** and ***n2*** represent a sequential list of input channels, inclusive.

LabVIEW and the Virtual Channel String

For LabVIEW, BridgeVIEW, Measure, and Visual Basic, the channel string can also contain virtual channels. For the SCXI-1104/C, these virtual channels are analog input channels you create that have custom names, called *tags* in BridgeVIEW, and perform scaling and linearization transparently without additional programming effort. Virtual channels are useful when sensors requiring different scaling factors are connected to the same SCXI-1104/C channel at different points in time. Using virtual channels, you can use sensors needing special scaling in a generic analog input application without performing hard-coded scaling or linearization. If the scaling changes or you want to connect a different sensor to your SCXI-1104/C, no changes are needed in the application. All you need to do is create a different virtual channel and use its name in the channel string.

Note You cannot mix virtual channels with the SCXI channel strings shown in *LabVIEW and the SCXI Channel String*.

To create a virtual channel for the SCXI-1104/C, insert a new analog input channel in the Data Neighborhood path in Measurement & Automation Explorer, name it, and follow the prompts to create a customized analog input channel. For more information about virtual channels, consult the Measurement & Automation online help file.

To use a virtual channel, enter its name into the channel string input of an analog input example or subVI. If using multiple virtual channels, separate them with commas or enter them in different elements in a channel string array. You can enter virtual channels in any order.

Multiplexed Scanning

To perform a multiplexed scan in your application, perform the following steps:

1. Open an analog input example in your ADE.
2. Enter the appropriate SCXI channel string or virtual channel string into the **channels** parameter.
3. Either enter the **input limits** for signals connected to your module to adjust the gain settings in your system, or use the default gain settings from the configuration utility, and then run the application. When using virtual channels, the default input limits configured in the virtual channel configurator are used.
4. You have completed a multiplexed scan using your SCXI-1104/C.

This is not a comprehensive discussion of SCXI scanning using LabVIEW, BridgeVIEW, Measure, or ComponentWorks, but should give you enough information to help you get started with the examples that are shipped with these software packages.

C and Low-Level DAQ Functions

When using a C-based environment, several steps are needed to configure the SCXI-1104/C for multiplexed scanning. The following procedure outlines the steps for programming with the low-level DAQ function calls:

1. Prepare your SCXI-1104/C settings by either loading the original SCXI configuration settings using `SCXI_Load_Config`.
2. Specify the module scan list, the start channel of each module, and the number of channels to scan on each module. This is done with the function, `SCXI_SCAN_Setup`. This function accepts an array of start channels and an array of the number of channels to scan in each module. Therefore, it is not possible to repeat channels or use nonsequential channels using this function.
3. Next, use `SCXI_MuxCtr_Setup` to program the DAQ device with the correct number of channels multiplexed per scan. This number must match the total number of channels programmed in step two.

You are now ready to acquire the channel data with the DAQ device. If you are using a multifunction DAQ device, you can use `SCAN_OP` to perform the scanning operation. After scanning, convert the binary data to voltage data using `SCXI_Scale`. Refer to the *NI-DAQ User Manual* for additional information on scanning with DAQ devices.

5

Theory of Operation

This chapter contains a functional overview of the SCXI-1104/C module and explains the operation of each functional unit making up the SCXI-1104/C module.

Functional Overview

The block diagram in Figure 5-1 illustrates the key functional components of the SCXI-1104/C module.

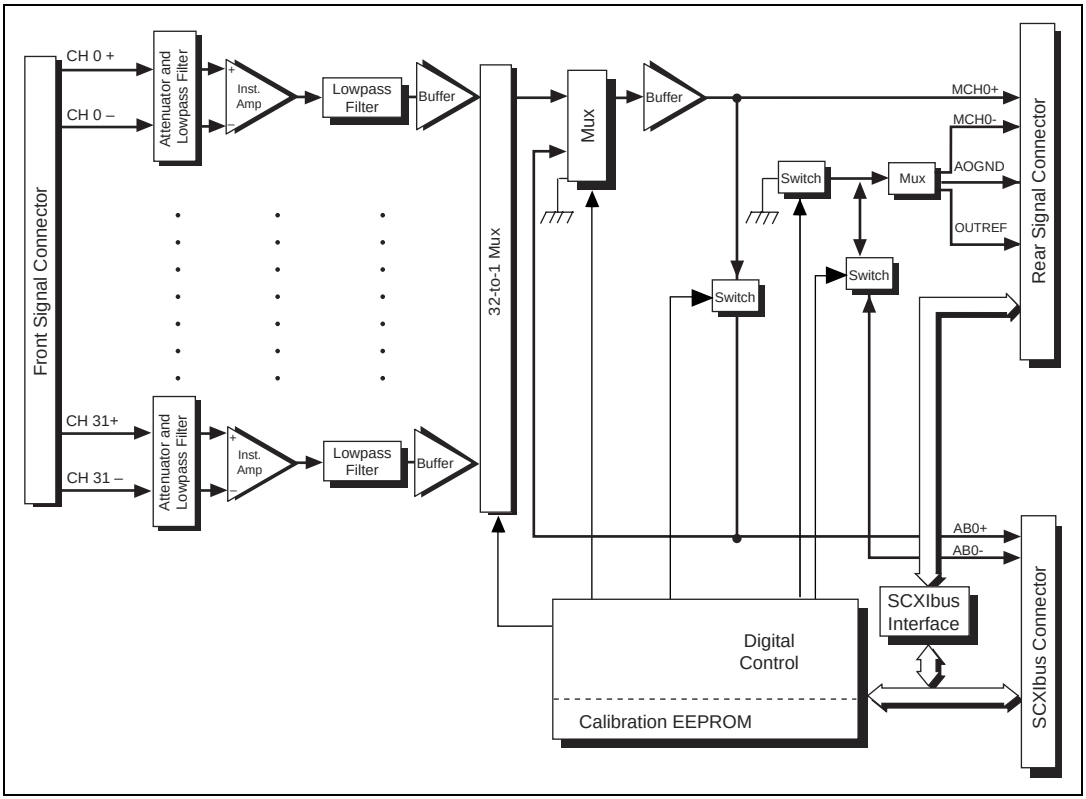


Figure 5-1. SCXI-1104/C Module Block Diagram

The major components of the SCXI-1104/C module are as follows:

- Rear signal connector
- SCXIbus connector
- SCXIbus interface
- Digital control circuitry
- Analog circuitry
- Front signal connector

Functional Unit Description

The SCXI-1104/C modules consist of 32 multiplexed input channels, each capable of measuring medium voltages. Each input channel has its own lowpass filter and amplifier. The SCXI-1104/C module also has a digital section for automatic control of channel scanning.

Rear Signal Connector, SCXIbus Connector, and SCXIbus Interface

The SCXIbus controls the SCXI-1104/C module. The SCXIbus interface connects the rear signal connector to the SCXIbus, allowing a DAQ device to control the SCXI-1104/C module and the rest of the chassis.

Digital Control Circuitry

The digital control circuitry consists of the Address Handler and the following registers:

- Module ID
- Configuration
- EEPROM
- Channel

The Address Handler controls which register is being addressed. The Module ID Register contains a code unique to each type of SCXI-1104 module:

- SCXI-1104—The Module ID is 45 decimal.
- SCXI-1104C—The Module ID is 47 decimal.

The Configuration Register configures the SCXI-1104/C module for the desired scanning mode and connection to the rear signal connector. The EEPROM Register is the address for interfacing with the module EEPROM, which contains calibration information. The Channel Register selects a channel for a single measurement or a start channel for a scan.

Analog Circuitry and Front Signal Connector

The analog circuitry per channel consists of a lowpass filter amplifier and a divide-by-10 attenuator. The channels are multiplexed to a single output buffer.

Analog Input Channels

Each of the 32 analog input channels feeds a separate amplifier and the signal passes through a three-pole lowpass filter.

For measurement accuracy of 0.012% of full scale, the minimum scan interval is 3 µs. This is the smallest interval in which you can switch between analog channels on the module and still measure voltages accurately. The 3 µs interval gives you a maximum sampling rate of 333 kHz. Because this rate is much higher than the bandwidth of a single SCXI-1104/C channel, you can sample multiple channels on multiple SCXI modules without undersampling one of the SCXI-1104/C channels.

Analog Bus Switches

The SCXI-1104/C module contains switches to route the multiplexer output to the SCXIbus. The SCXI-1104/C module also contains a switch to receive a signal placed on the SCXIbus by another SCXI module. The output buffer of the cabled module drives a received signal onto the MCH0+ line of its rear signal connector so that the DAQ device can read it. When a signal passes on the SCXIbus from the scanned SCXI module to the cabled SCXI module, the measurement is known as *indirect scanning*.

6

Calibration

This chapter discusses the calibration procedures for the SCXI-1104/C module.

Overview

Using the procedure described in this chapter, you can calculate the gain error and voltage offset on a per channel basis. You can store these constants in the onboard EEPROM for future use and for automatic calibration when you are using National Instruments software. The module comes from the factory with factory-determined calibration constants in the EEPROM. However, it is recommended that you recalibrate a module at least once per year or when you operate the module outside of the 20–30 °C temperature range.

To calibrate the SCXI-1104/C module, you need to apply precision voltages to the channel inputs and/or ground the channel inputs.

Calibration Procedure

This section describes the calibration equipment requirements and explains how to calibrate the offset and gain on the SCXI-1104/C module.

Calibration Equipment Requirements

According to standard practice, the equipment you use to calibrate the SCXI-1104/C module should be ten times as accurate as the SCXI-1104/C module. Calibration equipment with four times the accuracy of the SCXI-1104/C is generally considered acceptable.

To calibrate the SCXI-1104/C module, you need a voltmeter with the following specifications:

- Accuracy ±6 ppm standard reading
±15 ppm sufficient reading
- Resolution 8.5 digits

Using a multiranging 8.5-digit digital multimeter (DMM) you can perform the necessary calibrations.

To make sure that the DMM does not introduce an additional offset error, you can determine the offset error of the DMM by shorting its leads together and reading the measured value. You must subtract this value, the DMM offset, from all subsequent measurements.

You need to measure the output between MCH0+ and MCH0– of the module. To access these pins, connect an NB1 50-pin ribbon cable from a CB-50 I/O connector block to the module rear signal connector or to a rear signal cable adapter such as an SCXI-1349. Then connect to MCH0+ and MCH0– on the CB-50 pins 3 and 4, respectively.

Gain and Offset Calibration

For two-point calibration, it is best to use input voltages that correspond to the signal range of interest. For example, if you are planning to measure bipolar voltages over the full input range of the module, choose –42 V (negative full-scale) and +42 V (positive full-scale) as your two input voltages. If you are only concerned with offset error, short the input terminals and perform a one-point calibration on the channel using the `SCXI_Cal_Constants` NI-DAQ function or equivalent VI as described in your software documentation. To determine the offset and gain calibration factors of the SCXI-1104/C module for a given channel, perform the following steps for a two-point calibration:

1. Select the desired channel.
2. Apply the input for the first calibration point. To select negative full scale as the calibration point, apply –42 V for an input voltage.
   a. Apply the input voltage to the channel selected in step 1.

Note To make one of your calibration points be the zero point, connect the positive and negative channel leads to one of the chassis ground pins on the front connector or terminal block.

   b. Measure the input voltage with the DMM. Call the measured voltage `input1`.

Note If you are using a calibrator that supplies accurate voltages, you can simply use the known applied voltage for `input1` instead of measuring it.

   c. Measure the module output between MCH0+ and MCH0– with the DMM. Call the measured voltage `output1`.

3. Repeat step 2, applying the input for the second calibration point. Call the measured voltages `input2` and `output2`. To select positive full scale as the calibration point, repeat step 2 and apply +42 V.
4. You now have two pairs of voltages (`input1, output1`) and (`input2, output2`). Each pair consists of an input voltage and an output voltage.
5. Convert the output voltages from volt units to your DAQ device binary unit. You must take into consideration the polarity of your DAQ device, its resolution (12 bits or 16 bits), and gain. For example, if you are using the 12-bit AT-MIO-16E-2 in bipolar mode with the gain set to G_{MIO}, your output voltages are represented in binary units as given by the following formula:

$$Binary = \frac{Output}{5\ \mathrm{V}} \times 2^{12} \times G_{MIO}$$

   For other DAQ devices, refer to your DAQ device user manual to determine the appropriate formula.
6. You now have a new set of pairs referred to as voltage binary pairs (`input1, bin_output1`) and (`input2, bin_output2`). Pass these pairs to the `SCXI_Cal_Constants` NI-DAQ function or equivalent VI as described in your software documentation.

Note When you use 0 V and positive full-scale for your two calibration points, you eliminate the error at 0 V and at positive full-scale voltage. However, because of nonlinearity, the error at the negative full-scale voltage is two times the nonlinearity error. This is also true for the positive full-scale voltage if you use the negative full-scale voltage and 0 V as your two calibration points.

When you make a measurement using National Instruments software, the driver automatically uses the calibration constants to correct the measured voltages.

A

Specifications

This appendix lists the specifications for the SCXI-1104/C module. These specifications are typical at 25 °C unless otherwise noted.

Analog Input

Input Characteristics

Number of channels ..... 32 differential

Input signal ranges ..... 30 VAC_{rms}
±42 VAC_{peak}
±60 VDC

Max working voltage
(signal + common mode) ..... Each input should remain within ±42 VAC_{peak}, ±60 VDC of CGND

Input damage level ..... ±42 VAC_{peak} or ±60 VDC

Inputs protected..... CH<0..31>

Common-mode input range ..... ±60 VDC with respect to CGND

Transfer Characteristics

Nonlinearity ..... 0.01% FSR

Offset error

After calibration..... 300 µV max

Before calibration ..... 1 mV typ

Gain error (relative to calibration reference)

After calibration..... 0.02% of reading max

Before calibration ..... 0.1% of reading typ

Amplifier Characteristics

Input impedance

- Normal powered on .....1 MΩ
- Powered off .....900 kΩ
- Overload .....900 kΩ

Input bias current .....±0.5 nA

Input offset current .....±1.0 nA

CMRR

- 50 to 60 Hz .....70 dB
- DC.....70 dB

Output range .....±10 V

Output impedance.....91 Ω

Dynamic Characteristics

Bandwidth

- SCXI-1104.....2 Hz
- SCXI-1104C.....10 kHz

Minimum sample interval

- 0.012% accuracy.....3 µs
- 0.0061% accuracy.....10 µs

System noise (referenced to input) .....500 μV_{rms}

Digital Signals

Absolute max voltage input rating.....5.5 V with respect to DGND

Digital input specifications (referenced to DGND)

- V_{IH} input logic high voltage .....2 V min
- V_{IL} input logic low voltage.....0.8 V max
- I_I input current leakage .....±1 µA max

Digital output specifications (referenced to DGND)

- V_{OH} output logic high voltage .....3.7 V min at 4 mA max
- V_{OL} output logic low voltage .....0.4 V max at 4 mA max

Filters

Cutoff frequency (–3 dB)

SCXI-1104 ..... 2 Hz

SCXI-1104C ..... 10 kHz

NMR (60 Hz) ..... 40 dB (SCXI-1104)

Step response (either gain)

Accuracy	SCXI-1104	SCXI-1104C
To 0.1%	1 s	200 µs
To 0.01%	10 s	1 ms

Stability

Recommended warm-up time ..... 20 min

Offset temperature coefficient ..... 50 µV/°C

Gain temperature coefficient..... 20 ppm/°C

Note The offset and gain temperature coefficients apply outside the range of >35 °C and <15 °C.

Physical

Dimensions..... 11.5 by 27.3 cm (4.54 by 10.75 in.)

I/O connectors ..... 50-pin male ribbon cable rear connector
96-pin male DIN C front connector

Environment

Operating temperature..... 0 to 50 °C

Storage temperature ..... –55 to 150 °C

Relative humidity ..... 5% to 90% noncondensing

Power Requirements

5 V supply.....15 mA max

±15 V supply (regulated
from ±24 V supply) .....150 mA max

B

Common Questions

This appendix lists common questions related to the use of the SCXI-1104/C.

What is the difference between the SCXI-1104 and SCXI-1104C?

The SCXI-1104 has a fixed cutoff frequency of 2 Hz. The SCXI-1104C has a fixed cutoff frequency of 10 kHz. They are identical in all other respects. The SCXI-1104 is commonly used to measure slowly-varying medium-voltage signals in a high-noise environment. The SCXI-1104C is commonly used to measure time-varying medium-voltage signals.

What are the similarities and differences between the SCXI-1102/B/C and the SCXI-1104/C?

These modules have a similar internal architecture. Each channel has its own amplifier and filter, which makes scanning trouble-free compared to a shared-amplifier-and-filter architecture. All 32 differential input channels are multiplexed to a single output channel and then routed to the DAQ device, either directly or through the SCXIbus. Both modules have a fixed cutoff frequency.

You can configure the SCXI-1102/B/C for a gain of either 1 or 100 while the SCXI-1104/C has a fixed gain of 0.1 only.

Can you use the SCXI-1104/C for mV measurements, such as temperature measurement using thermocouples?

No. The SCXI-1104/C is optimized for medium-voltage measurements, not low-voltage measurements. If you need to make low-voltage measurements select the SCXI-1102/B/C instead.

Can you read the voltage produced by the temperature sensor on the SCXI-1300 terminal block when it is attached to an SCXI-1104/C?

No. You can use only channels 0 through 31 to take voltage measurements. Figure 5-1, *SCXI-1104/C Module Block Diagram*, shows that the temperature sensor signal is not routed from the front signal connector to the SCXI-1104/C multiplexer.

Which version of the NI-DAQ driver software is needed to use the SCXI-1104/C?

NI-DAQ version 6.5.1 or later is required for the SCXI-1104. NI-DAQ version 6.7 or later is required for the SCXI-1104C.

How do I obtain the most current version of NI-DAQ?

Visit our Web site and follow the link, **Download Software»Drivers and Updates»Search Drivers and Updates**, and type in the keyword `NI-DAQ` to find the latest version of NI-DAQ for your operating system.

I have gone over *Configuration and Self-Test* in Chapter 2, *Installation and Configuration* yet I still cannot correctly test and verify that my SCXI-1104/C is working. What should I do now?

Unfortunately, there always exists the chance that something is not operating correctly in your system, or the combination of the components in your system is not operating correctly together. You may have to call or e-mail a technical support representative.

The technical support representative will often suggest additional troubleshooting measures to isolate the problem. If requesting technical support by phone, have your system nearby so you can try these measures immediately. National Instruments contact information is listed in Appendix C, *Technical Support Resources*.

How do I configure an SCXI-1200 for use with an SCXI-1104/C module?

When using the SCXI-1200 with the SCXI-1104/C, make sure the SCXI-1200 is configured for NRSE mode in the Measurement & Automation Explorer.

Can I use onboard channels one through seven on the DAQ device if it is connected directly to an SCXI-1104/C module?

Yes. Only onboard channel zero is reserved for use by the SCXI chassis in this case.

Which digital lines are unavailable on the DAQ device if it is directly connected to an SCXI-1104/C module?

Table B-1 shows the digital lines that are used by the SCXI-1104/C for communication and scanning. These lines are unavailable for general-purpose digital I/O if the SCXI-1104/C is connected to the DAQ device.

Table B-1. Digital Signals on the SCXI-1104/C

DAQ Signal Name	SCXI Signal Name	50-Pin Connector	68-Pin Connector	Direction
DIO0	SERDATIN	25	52	Output
DIO4	SERDATOUT	26	19	Input
DIO1	DAQD*/A	27	17	Output
DIO2	SLOT0SEL*	29	49	Output
SCANCLK	SCANCLK	36	46	Output
EXTSROBE*	SERCLK	37	45	Output
STARTSCAN	SYNC*	46	38	Output

Is there any way to change the cutoff frequency and gain of each channel on an SCXI-1104/C module, either using software or by modifying the circuitry of the module?

No. All channels share the same gain and cutoff frequency and you cannot modify them.

Some SCXI modules, such as the SCXI-1112 and SCXI-1125, permit random scanning. Does the SCXI-1104/C permit random scanning?

No. You must scan channels in consecutive ascending order and you cannot repeat any channels.

Can I configure and use the SCXI-1104/C in parallel mode?

No. You can only use the SCXI-1104/C in multiplexed scanning mode.

Which accessories can I use to connect signals to the front signal connector of the SCXI-1104/C?

You can use the SCXI-1300 front-mounted terminal block, BNC-2095 rack-mounted BNC connector accessory, TBX-96 DIN-rail terminal block, or the SCXI-1310 connector-and-shell kit.

I cannot find an installation guide for the SCXI-1300 terminal block. Where can I get technical information about the SCXI-1300 terminal block?

You can only obtain this information from the *SCXI-1100 User Manual*.

C

Technical Support Resources

This appendix describes the comprehensive resources available to you in the Technical Support section of the National Instruments Web site and provides technical support telephone numbers for you to use if you have trouble connecting to our Web site or if you do not have internet access.

NI Web Support

To provide you with immediate answers and solutions 24 hours a day, 365 days a year, National Instruments maintains extensive online technical support resources. They are available to you at no cost, are updated daily, and can be found in the Technical Support section of our Web site at `www.ni.com/support`

Online Problem-Solving and Diagnostic Resources

- **KnowledgeBase**—A searchable database containing thousands of frequently asked questions (FAQs) and their corresponding answers or solutions, including special sections devoted to our newest products. The database is updated daily in response to new customer experiences and feedback.
- **Troubleshooting Wizards**—Step-by-step guides lead you through common problems and answer questions about our entire product line. Wizards include screen shots that illustrate the steps being described and provide detailed information ranging from simple getting started instructions to advanced topics.
- **Product Manuals**—A comprehensive, searchable library of the latest editions of National Instruments hardware and software product manuals.
- **Hardware Reference Database**—A searchable database containing brief hardware descriptions, mechanical drawings, and helpful images of jumper settings and connector pinouts.
- **Application Notes**—A library with more than 100 short papers addressing specific topics such as creating and calling DLLs, developing your own instrument driver software, and porting applications between platforms and operating systems.

Software-Related Resources

- **Instrument Driver Network**—A library with hundreds of instrument drivers for control of standalone instruments via GPIB, VXI, or serial interfaces. You also can submit a request for a particular instrument driver if it does not already appear in the library.
- **Example Programs Database**—A database with numerous, non-shipping example programs for National Instruments programming environments. You can use them to complement the example programs that are already included with National Instruments products.
- **Software Library**—A library with updates and patches to application software, links to the latest versions of driver software for National Instruments hardware products, and utility routines.

Worldwide Support

National Instruments has offices located around the globe. Many branch offices maintain a Web site to provide information on local services. You can access these Web sites from `www.ni.com/worldwide`

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Italy 02 413091, Japan 03 5472 2970, Korea 02 596 7456,
Mexico (D.F.) 5 280 7625, Mexico (Monterrey) 8 357 7695,
Netherlands 0348 433466, New Zealand 09 914 0488,
Norway 32 27 73 00, Poland 0 22 528 94 06, Portugal 351 1 726 9011,
Singapore 2265886, Spain 91 640 0085, Sweden 08 587 895 00,
Switzerland 056 200 51 51, Taiwan 02 2528 7227,
United Kingdom 01635 523545

Glossary

Prefix	Meanings	Value
p-	pico-	10^{-12}
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}
G-	giga-	10^{9}

Numbers/Symbols

+5 V	+5 volt signal
°	degrees
Ω	ohms
%	percent
±	plus or minus

A

A	amperes
AC	alternating current
ACH	analog input channel signal
A/D	analog-to-digital
ADC	analog-to-digital converter—an electronic device, often an integrated circuit, that converts an analog voltage to a digital number

ADE	application development environment such as LabVIEW, LabWindows/CVI, BridgeVIEW, Visual Basic, C, and C++
AIGND	analog input ground signal
AOGND	analog output ground signal
AWG	American Wire Gauge

B

BCD	binary-coded decimal
bias current	the small current flowing into or out of the input terminals of an amplifier
bipolar	a voltage range spanning both negative and positive voltages
bus	the group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are the ISA bus and PCI bus.

C

C	Celsius
CGND	chassis ground potential
CH	channel
channel	pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
chassis	the enclosure that houses, powers, and controls SCXI modules
CLK	clock input signal
CMOS	complementary metallic oxide semiconductor
CMRR	common-mode rejection ratio
cutoff frequency	the frequency that defines the upper end of the passband of a lowpass filter

D

D/A	digital-to-analog
DAQ	data acquisition—(1) collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) collecting and measuring the same kinds of electrical signals with A/D and/or DIO devices plugged into a computer, and possibly generating control signals with D/A and/or DIO devices in the same computer
DAQD*/A	the signal used to indicate whether the SERDATIN pulse train transmitted to the SCXI chassis contains data or address information
dB	decibel—the unit for expressing a logarithmic measure of the ratio of two signal levels: $dB=20\log_{10} V1/V2$, for signals in volts
DC	direct current
device	a plug-in data acquisition board, module, card, or pad that can contain multiple channels and conversion devices. SCXI modules are distinct from devices, with the exception of the SCXI-1200, which is a hybrid.
DGND	digital ground signal
DIFF	differential input mode
differential input	an analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured
DIN	Deutsche Industrie Norme
DMM	digital multimeter
DOUT	digital output signal
drivers/driver software	software that controls a specific hardware device such as a DAQ device

E

EEPROM	electrically erasable programmable read-only memory—ROM that can be erased with an electrical signal and reprogrammed

F

F	farads
FIFO	first-in first-out memory buffer—the first data stored is the first data sent to the acceptor. FIFOs are often used on DAQ devices to temporarily store incoming or outgoing data until that data can be retrieved or output. For example, an analog input FIFO stores the results of A/D conversions until the data can be retrieved into system memory, a process that requires the servicing of interrupts and often the programming of the DMA controller. This process can take several milliseconds in some cases. During this time, data accumulates in the FIFO for future retrieval. With a larger FIFO, longer latencies can be tolerated. In the case of analog output, a FIFO permits faster update rates, because the waveform data can be stored on the FIFO ahead of time. This again reduces the effect of latencies associated with getting the data from system memory to the DAQ device.
FSR	full-scale range

G

G	gain
gain error	the difference between the actual and intended gain of a system

H

hex	hexadecimal
Hz	hertz—the number of scans read or updates written per second

I

in.	inches
indirect scanning	the measurement that occurs when a signal passes on the SCXIbus from the scanned SCXI module to the cabled SCXI module
input damage level	the highest voltage level that you can apply to the module without damaging it

I/O	input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces
ISA	Industry Standard Architecture

L

lowpass filter	a filter that passes signals below a cutoff frequency while blocking signals above that frequency
LSB	least significant bit

M

max	maximum
MCH	multiplexed channel
MIO device	refers to the multifunction I/O DAQ devices that have *MIO* or 60*XX* in their names
MSB	most significant bit
mux	multiplexer

N

NC	not connected (signal)
NI-DAQ	the driver software needed in order to use National Instruments DAQ devices and SCXI components
NMR	normal-mode rejection
nonlinearity	a measure, in percent of full-scale range, of the worst-case deviation from the ideal transfer function of an amplifier, which is a straight line
NRSE	nonreferenced single-ended mode—all measurements are made with respect to a common (NRSE) measurement system reference, but the voltage at this reference can vary with respect to the measurement system ground

O

offset error	the output of a system with a zero-volt input
OUT	output signal
OUTREF	output reference signal

P

PC	personal computer
PCMCIA	an expansion bus architecture that has found widespread acceptance as a de facto standard in notebook-size computers. It originated as a specification for add-on memory cards written by the Personal Computer Memory Card International Association.
pole	A term used to describe the quality of a lowpass filter. In general, the more poles a lowpass filter has, the better it attenuates frequencies beyond the cutoff frequency.

R

RMA	Return Material Authorization
rms	root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude
RSVD	reserved pin
RTSI bus	real-time system integration bus—the National Instruments timing bus that connects DAQ devices directly, by means of connectors on top of the devices, for precise synchronization of functions

S

S	samples
s	seconds
sample	an instantaneous measurement of a signal, normally using an analog-to-digital convertor in a DAQ device

scan	a collection of samples, usually with each sample coming from a different input channel
SCANCLK	scan clock signal used to increment to the next channel after each DAQ device analog-to-digital conversion
SCXI	Signal Conditioning eXtensions for Instrumentation—the National Instruments product line for conditioning low-level signals within an external chassis near sensors so only high-level signals are sent to DAQ devices in the noisy PC environment
SCXIbus	SCXIbus refers to the backplane in the chassis. A signal on the backplane is referred to as the SCXIbus <signal name> line (or signal). The SCXIbus descriptor may be omitted when the meaning is clear. Descriptions of many SCXIbus signals are in Chapter 3, *Signal Connections*.
SERCLK	serial clock signal
SERDATIN	serial data input signal
SERDATOUT	serial data output signal
signal conditioning	the manipulation of signals to prepare them for digitizing
Slot 0	refers to the power supply and control circuitry in the SCXI chassis
SLOT0SEL*	Slot 0 select signal

T

TTL	transistor-transistor logic

V

V	volts
VDC	volts, direct current
VI	virtual instrument—(1) a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument (2) a LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program

V_{IH}	volts, input high
V_{IL}	volts, input low
V_{in}	volts in
V_{OH}	volts, output high
V_{OL}	volts, output low

W

working voltage	the highest voltage that should be applied to a product in normal use, normally well under the breakdown voltage for safety margin

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